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Research Report

STEALTH IN THE STORM

SORTING THE FACTS FROM THE FICTION

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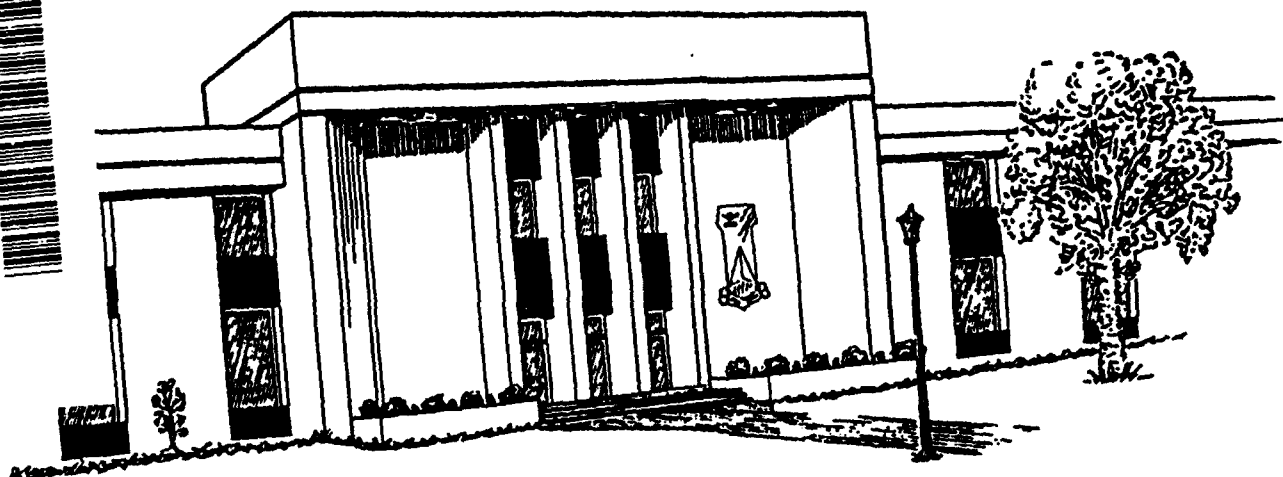
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STEALTH IN THE STORM
Sorting the Facts from the Fiction

by Lt Col Ralph W. Getchell

As we pass the first anniversary of DESERT STORM, the public debate over the value of the B-2 Stealth Bomber has heated up once again. While much of the earlier opposition to future production of this third generation stealth aircraft has understandably centered on the issue of affordability, some circles are now questioning the actual effectiveness of U.S. stealth technology.

Since the specific radar evading capabilities of the B-2 are among this nation's most closely guarded secrets, these critics are now basing their challenge on allegations by unnamed sources that the Lockheed F-117 Stealth Fighter did not perform as well in DESERT STORM as initially claimed. At the same time, they accuse the Air Force of revising the F-117's war record to support a troubled B-2 acquisition program.

As one of the 60 pilots who saw DESERT STORM firsthand from the cockpit of an F-117, this writer is admittedly biased in favor of stealth technology. We believe in it. We've seen its capability firsthand. It was responsible for our success in the Storm. It was responsible for our survival. We also believe that public debate over continued investment in stealth technology should be based on the facts, not hearsay. So here are a few.

On the eve of DESERT STORM, the F-117A, like most of the pilots who flew her, was unproven in battle. From the exhaustive classified test reports available, we knew the aircraft's low observable characteristics would give us a substantial advantage over the Iraqi interceptors, surface to air missiles (SAMs), and anti-aircraft artillery (AAA) which were ready to oppose our attack. But the F-117 is LOW observable, not NO observable. In planning our attack routes, we carefully took advantage of our strengths to minimize the times during which we could possibly be detected and tracked. However, there would be significant risks even if both the aircraft and the enemy performed as expected.

In wartime, the unexpected sometimes happens. Maintenance access panels inexplicably come off in flight, bomb bay doors fail to close, or an enemy SAM proves more capable than previously thought. The 19th Century Prussian strategist Carl von Clausewitz termed such occurrences the friction of war. Friction can disrupt the most capable army or doom an otherwise clever strategy unless campaign plans provide a margin for the unexpected.

The F-117 had a critical role in the opening days of the campaign. Our initial tasking was to disrupt the ability of Iraqi's national leadership to mount an effective defense against

the Coalition air forces - to stun the brain while other aircraft struck the extremities. Because this mission required a large number of heavily defended targets to be hit by a relatively small force of F-117s, few targets could be struck more than once. If the friction of war prevented even a few of the F-117s from accomplishing their mission, the non-stealthy attackers that followed in successive waves might face an even more determined resistance.

It was the prospect of friction which prompted our unit to request EF-111 Raven jamming support for the first nights' operations. Based on peacetime exercises such as RED FLAG, we knew enemy radar operators usually try to counter electronic jamming by reducing the sensitivity or "gain" of their radar receiver. Any reduction in gain would cause the small radar blip of a malfunctioning F-117 to disappear from the scope.

To the Stealth planners, Raven jamming seemed like good insurance. CENTAF agreed. But jamming would only be provided around the Baghdad area, which was defended by an estimated 60 SAM batteries and 1800 AAA guns. F-117s attacking less heavily defended targets were not directly supported by the Ravens.

EF-111 Ravens were never tasked to escort the F-117s *per se*. As a practical matter, it is extremely difficult, if not impossible, to fly formation with the F-117, which is designed to be visually as well as electronically elusive at night. Further, the close proximity of non-stealthy Ravens would have helped the enemy predict our proximate location and attack route. Instead, the EF-111s entered enemy airspace on their own and began jamming at the agreed upon time and place. At the end of the allotted time, the Ravens turned off their electronic jammers and proceed to other jamming assignments to support non-stealthy aircraft. The F-117s and EF-111s never saw or heard each other over Iraqi territory.

Further, since EF-111 jamming was a precaution not a necessity, no provision was made to cancel the attack or even notify the attacking Stealth Fighters should the Ravens be forced to abort their mission. Sometimes you have to live without insurance.

Throughout the conflict, neither the F-15 Eagles nor the F-4G Wild Weasels, which were routinely tasked to support non-stealthy strike packages, were ever tasked to escort or protect the F-117s.

After the attack was completed and the target area left far behind, our biggest concern was getting back to home base without a midair collision. Even at night, there were literally hundreds of fighters, bombers, tankers and other aircraft moving back and forth across and along the Iraqi border. Over enemy territory, most Coalition aircraft turned off their external lights to prevent detection by Iraqi defenders. During the relatively

short period when the Iraqi Air Force tried to oppose the campaign, the presence of their MiGs and Mirages. (with Coalition F-15s in hot pursuit!) was always a possibility. Therefore, positive radar control, flight discipline, and an effective airspace control plan were essential.

To comply with this plan, Stealth Fighters would "de-stealth" by changing their external configuration well prior to reaching the border and activating Identification Friend or Foe (IFF) equipment which transmitted coded pulses in response to friendly search radars like AWACS, E-2Cs, etc. In this "de-stealthed" condition, the F-117 can sometimes be detected at long range by certain radars, but the importance of avoiding a midair collision overrode the threat of being seen by the enemy.

As the war continued, the Ravens were occasionally tasked to provide standoff jamming for F-117 attacks. These missions were not tasked to counter the SAMs (which failed to demonstrate any real capability against the F-117) but to elicit a poorly timed response from the hundreds of AAA guns which protected important targets. Many of Iraqi's AAA batteries lacked radar for detection and tracking, but opened fire on cue from the more sophisticated systems or from listening posts on the outskirts of town. Anyone who has seen CNN's videos of downtown Baghdad at night can appreciate what a serious threat this unaimed or barrage AAA could be to ANY aircraft which flew over the city.

After the first few days of combat, we discovered that well-timed jamming by the Ravens caused the gunners to fire blindly into the air until they ran out of ammunition or overheated their barrels. When the firing died down, the F-117s could then attack with much less risk of damage from unaimed flak. "Flak baiting" became a secondary or tertiary mission for the EF-111 crews, who spent most of their time providing jamming support for non-stealthy strike aircraft. It was a smart tactic made possible by the campaign's strategy of first neutralizing the enemy's centralized command and control system.

Iraq had a lot of radars and replacement parts in storage. After the Air Force and Navy used High speed Anti-Radiation Missiles (HARM) to destroy a large number of search and SAM radars in the early hours of the campaign, the Iraqis were able to reestablish some key radar installations with substitute radars held in reserve. In one case, the Iraqis replaced a low frequency Long Track search radar with a very capable Chinese version. Although this Chinese radar was in an area protected by SAMs, a single F-117 was able to attack and destroy it virtually unopposed.

Similarly, the Iraqis were able to reconstitute a number of SAM sites by replacing acquisition and target tracking radars destroyed by the F-4G Wild Weasels. One evening when the Weasels were otherwise occupied, F-117s destroyed several SAM sites by

attacking them in flight profiles which would have been prohibitively hazardous to non-stealthy aircraft.

By the end of the war, the F-117 Stealth Fighters had flown 1271 combat sorties - about one third of these against Baghdad targets. Despite the heavy defenses surrounding the city, the Stealths went Downtown with relative impunity, fearing only an unlucky burst of unaimed AAA. Yet, contrary to rumor, the F-117s did not receive even a scratch of battle damage throughout the war.

According to Lieutenant General Charles A. Horner, the CENTAF commander, only the F-117 was routinely sent against the heart of the enemy's capital. This was a practical, not a political policy. There were plenty of valid targets all over Iraq that needed to be destroyed in only 43 days. Why unnecessarily risk "high-observable" aircraft over Baghdad when the F-117s could do the job so well?

Critics who complain that the F-117's "no-scratch" combat record was not significantly better than other Coalition fighter-bombers (for example, no F-111s were lost in combat) are trying to compare apples and oranges. Aircrews who flew there know that "Downtown" was, by far, the roughest game around. Only the F-117s played it night after night.

Throughout DESERT STORM, the F-117 Stealth Fighter consistently lived up to our pre-war expectations. On a daily basis, we demonstrated the F-117 can operate and survive alone against very sophisticated and lethal defenses. Although we asked for occasional Raven support to overcome anticipated frictions of war, the F-117 proved to be very reliable under combat conditions. In fact, because we made the friction of war work against the Iraqis, the aircraft performed even better than we predicted.

DESERT STORM proved the ability of stealth technology to save lives and achieve unprecedented effectiveness in combat. However, it also demonstrated the dangers of regional conflict. Our readiness to influence the outcome of future struggles may depend on how well we use this high leverage, uniquely American, technological advantage in our future force structure. While the fiscal realities of our post-cold war economy may severely limit our ability to field stealthy aircraft in the immediate future, the facts of DESERT STORM demonstrate that continued research and development of stealthy weapons is a smart national investment.

About the author: Air Force Lt Col Getchell is a student at the Air War College, Maxwell Air Force Base, Alabama. During DESERT SHIELD/DESERT STORM, he commanded the F-117A equipped 415th Tactical Fighter Squadron and flew 18 missions over Iraq. Lt Col Getchell has given testimony on stealth capabilities to the Senate Armed Services Committee and the House Appropriations Committee Defense Subcommittee.

STEALTH IN THE STORM Sorting the Facts from the Fiction

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The truth is sometimes hard to find when the stakes are high. Self-styled experts are eager to publicize unconfirmed reports to corroborate their point of view. Uninformed media interviewers often miss or misinterpret technical nuances in their quest for news. Sometimes, interviewed experts can't effectively distill an answer into a 30 second sound bite. Before long, fiction is confused with, and accepted as fact.

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With the exception of the two most senior officers in our wing, none of the Stealth pilots who fought in DESERT STORM had ever before faced the kind of lethal opposition we would encounter over Iraq those first few nights. For all the thousands of hours of peacetime flying we had behind us, as individual fighter pilots we were yet unproven in battle. The ultimate test lay ahead. On the first nights, I'm sure there were silent prayers for inner strength and success in each of those single seat cockpits.

The F-117A was also unproven in battle. From the exhaustive classified test reports available, we knew the aircraft's low observable characteristics would give us a substantial advantage over the Iraqi interceptors, surface to air missiles (SAMs), and anti-aircraft artillery (AAA) which were ready to oppose our attack. But the F-117 is LOW observable, not NO observable. In

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The early success of the DESERT STORM air campaign depended on near flawless performances by a number of participants. Tomahawk missiles had to hit their designated targets, pre-strike tankers had to refuel the fighters, Apache helicopters had to knock out early warning radars for the F-15Es, and the F-4G Wild Weasels had to suppress the SAM sites. Any major failure to achieve individual mission objectives could have had disastrous effects on the larger attacking force which followed. Aircraft could have been destroyed - perhaps aircrews killed or taken prisoner. To prevent this from happening, war planners tried to build enough redundancy into each strike or support package to overcome the unexpected.

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One often overlooked facet of the Iraqi war machine is the extent of the resources which Saddam had stockpiled prior to the war. He didn't have a few ammunition storage bunkers, he had thousands of them. He didn't have one chemical weapons production facility, he had several. His military industrial complex at Taji was described in Congressional testimony by Brig Gen Buster Glosson as five times larger than the massive U.S. production facility at Ft Worth, Texas. It takes a lot of bombs, and a lot of fighters, to destroy a target like that.

Iraq also had a lot of radars and replacement parts in storage. After the Air Force and Navy used High speed Anti-Radiation Missiles (HARM) to destroy a large number of search and SAM radars in the early hours of the campaign, the Iraqis were able to reestablish some key radar installations with substitute radars held in reserve. In one case, the Iraqis replaced a low frequency Long Track search radar with a very capable Chinese version. Although this Chinese radar was in an area protected by SAMs, a single F-117 was able to attack and destroy it virtually unopposed.

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Low observable technology is a revolutionary innovation, not a gimmick. Not only does it deliver unprecedented SURPRISE and SURVIVABILITY against enemy threat radars, it also permits unparalleled weapons delivery ACCURACY. Even in the highest threat environment, the F-117 pilot does not have to violently maneuver his aircraft in the final stages of his bomb run to avoid fire from point defenses. Instead, he can devote his attention to finding the target and precisely guiding his weapons to the exact impact point desired.

This phenomenal accuracy allowed us to find and destroy small targets located in crowded urban areas without unnecessarily endangering civilians living nearby. Command and control centers built to withstand blasts from conventionally delivered munitions were routinely neutralized by F-117 delivered bombs which penetrated through exposed ventilator shafts. During the Gulf War, the F-117's superb accuracy not only help minimize Coalition casualties, it spared the lives of innocent Iraqi civilians as well.

DESERT STORM proved that stealth works. But can that experience help us accurately assess the true potential of stealth technology in the future? Will stealth be as effective against adversaries more advanced than the Iraqis? Will this technology be obsolete in only a few years?

Fortunately, our DESERT STORM experience also proved the relevance of our testing process as an accurate predictor of stealth performance. As a result, our elected national leaders, including select members of Congress, already know how well the newer stealth aircraft should perform against known and expected threat radars in worst case conditions.

The vocal majority of stealth critics don't. If they did, they'd be believers too. However, since the American taxpayer has paid billions of dollars to produce low observable aircraft, it would be imprudent to open our test data to public examination and thus reveal these expensive secrets to potential adversaries. Nonetheless, we can draw some useful conclusions about future benefits of low observable technology with a simple model.

Our model assumes that in order receive production approval, a stealthy weapon must have a substantial capability against defensive systems currently fielded at the time of the production decision. It doesn't have to be totally invisible to these systems, just significantly less detectable and more survivable than a non-stealthy vehicle.

Defensive systems fielded after the production decision may or may not have a better capability to detect and track the now operational stealth system. However, signals intelligence and test data will accurately predict the extent of that capability and allow stealth mission planners to develop attacks which capitalize on the aircraft's strengths and offset any weakness.

The stealth model is easily applied. During DESERT STORM, the F-117, which was approved for production in 1978, met 60's and 70's (and some 80's) defensive technology. Our technology proved to be a revolutionary advance in combat capability. Against similarly arrayed and equipped defenses, and with the same excellence in planning, command, and execution, we should expect similar results. It is important to remember that there is a lot of this '60s and '70's technology in national inventories worldwide. And will be for some time to come.

Against 80's and 90's technology, the older F-117 MAY not be as capable. However, its stealthiness will still give the F-117 an order of magnitude advantage over non-stealthy aircraft. Radars which can detect the F-117 under some conditions should have an even greater capability to detect and track non-stealthy aircraft so the F-117 will still retain a comparative advantage. With a 1990 production decision, the B-2 should and will have a substantially better capability against these newer defenses.

Edward N. Luttwak, in his book Strategy: The Logic of War and Peace, observes that historically the introduction of a breakthrough technology to the battlefield will prompt the adversary to develop a countermeasure in an action-reaction sequence which will, in turn, prompt development of a counter-counter measure. He argues that the more successful the new technology, the more urgent will be the adversary's efforts to develop a counter. As a corollary, less successful innovations may retain their utility longer than the true breakthrough weapon.

Luttwak's observations are often used to argue against stealth aircraft. Opponents of stealth assert that "super"

radars have been and will be developed which will effectively counter the advantages of low observable aircraft. They then conclude that we might as well save our money and invest elsewhere.

However, as we know from our own experience, there is a big difference between development and force-wide acquisition. New technology costs money, and few nations these days feel threatened enough or possess the resources to replace ALL their search radars or ALL their SAMs or all their radar-aimed AAA with new systems. HARMs or cruise missiles could quickly defeat a few breakthrough radars early in an air campaign to allow stealth aircraft to operate with relative impunity. Without a wholesale upgrade to a "super" system, an adversary's air defense system could still be exploited by the "older" stealth aircraft.

In this light, the F-117 and its newer stealth cousins should retain many advantages for some time to come. Moreover, it should be noted that while signals intelligence can provide us with accurate predictions of stealth performance against a given radar, the opposite is not necessarily true. To paraphrase an old adage, beauty may be skin deep, but stealth goes all the way to the bone. One cannot determine a radar's effectiveness against a stealthy vehicle by looking at pictures, you must actually try it against a "stealthed up" aircraft.

If we follow Luttwak's warning to carefully manage a potential adversary's exposure to a new weapon, by limiting training areas and attaching radar reflectors as we did for much of the life of the F-117, we can also delay development of effective countermeasures to future stealthy weapons. Thus, U.S. stealth technology should give us a substantial advantage in SURPRISE, SURVIVABILITY and ACCURACY in the years ahead.

It is these benefits which make a stealth bomber, with its greater range and payload capability, a logical next step from an tactical AND economic point of view.

The ability to operate without tankers gives a stealth bomber a tremendous tactical advantage over its smaller brothers. Our current generation of tankers can be detected from great distances by modern early warning radars. Without the need to refuel immediately prior to penetrating enemy territory, a stealthy bomber can secretly approach an unfriendly border without the tankers giving him away. Long range is also a necessity in scenarios in which developed forward bases like those we enjoyed in Saudi Arabia are not available.

A bomber's greater payload allows it to destroy large target arrays with a single pass over the target. During DESERT STORM, about eighteen F-117 sorties were required to destroy the 36-odd aircraft shelters found in a typical Iraqi airfield. With smart bombs, two B-2s could do the job without tankers or other support of any kind.

It is tempting to take this eighteen F-117 versus two B-2 correlation (or the 55 non-stealthy aircraft versus eight F-117 versus two B-2 example presented in Congressional testimony for a different type target) and compare the two force structures based solely on aircraft acquisition costs. Such comparisons are estimates because they do not consider the other costs associated with operating an aircraft over its useful life. For example, when costs for fuel, parts, and personnel for aircraft support are factored in, a stealth bomber becomes an even better defense value.

In summary, DESERT STORM proved the ability of stealth technology to save lives and achieve unprecedented effectiveness in combat. However, it also demonstrated the dangers of regional conflict. Our readiness to influence the outcome of future struggles may depend on how well we use this high leverage, uniquely American, technological advantage in our future force structure. While the fiscal realities of our post-cold war economy may severely limit our ability to field stealthy aircraft in the immediate future, the facts of DESERT STORM demonstrate that continued research and development of stealthy weapons is a smart national investment.

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The Real 'Stealth' Is in the Tactics of Planes' Backers

By Andy Ireland

OPPONENTS of the B-2 bomber and doubters of Stealth technology are breathing a sigh of relief because the B-2 program was effectively put on hold by this year's vote on defense appropriations. But they should not rest easy.

Proponents of Stealth technology and the B-2 are quietly working to boost the credibility of both the plane and technology. They are busy revising the war record of the F117A Stealth airplane in an effort to prove that Stealth technology works. The ugly secret that Stealth proponents have so far been able to keep out of the public debate is that there are already radars on the

The Air Force has admitted in recent weeks that a few F117A Stealth airplanes, widely credited with flying over Baghdad "alone and unafraid," had to be escorted by Air Force EF-111 and Navy EA-6B electronic jamming aircraft. My sources tell me that, in fact, significant numbers of F117As had to be escorted by radar-jamming escort planes because these supposed "invisible" aircraft were being tracked by low-frequency Chinese- and French-made radars located in Iraq. In addition, these sources tell me that during the war the F117As could be tracked by Navy E-2C aircraft from a distance of more than 100 miles.

The United States lost no F117As in the Gulf. This is a significant statistic of which to be proud. However, it is crucial to the nation's security and the future of our defense planning that we be under no illusions about the reasons for this zero-loss rate. Having Stealth airplanes escorted by planes with electronic jamming equipment is the antithesis of Stealth. Electronic jammers are like a bell on a cat's collar. They announce the creature's presence to every target in the area.

The development of radars that can detect Stealth aircraft raises important questions: Has the Air Force tested Stealth planes against all possible forms of radar? Can Stealth technology yield a militarily useful reduction in radar visibility at an affordable price? With the threat of a nuclear war with the Soviet Union dissolving, should the US continue its policy of Stealth at any price?

On Nov. 14, 1991, I wrote Secretary of Defense Dick Cheney to request that the B-2 bomber be subjected to a series of independent radar tests, to determine how difficult it is to detect the aircraft, and thus measure its true survivability. These tests would be conducted against an array of radars already used by third-world countries, including low-frequency radars (those used by Iraq during the war) and ultra wide-band or time domain pulse radars. The Customs Service has agreed to conduct the tests using AEW aircraft with modified E-2C radar. These radars are very similar to those in use in Iraq, China, the Soviet Union, and other third-world countries that I believe can detect Stealth aircraft. The tests would be observed by a trained, objective, and independent observer to verify the results.

I believe these tests will prove that the B-2 Stealth plane is detectable by radars already in use in the third world. In addition, the technological sophistication of these radars is increasing all the time, as is knowledge of the way Stealth technology is designed. If the B-2 can be detected after the US has poured over \$30 billion into a development program for it, we must then worry about the viability of the other "Stealth" development programs that Congress has approved. The defense appropriations bill for 1992 contains billions in funds to continue development of the B-2 program, the Air Force's Advanced Tactical Fighter, the Navy A-X program, and for the Tri-Service Standoff Attack Missile.

The debate about Stealth technology will continue. Because the B-2 program was temporarily put on hold by this year's defense appropriation does not mean it won't be a topic for debate next year. Those who argue for additional funding for the B-2 want, in the tradition of Pentagon spending, to pour money down a rat hole. I urge Mr. Cheney to hold independent tests of the B-2. It is essential that we determine now, before billions more dollars are spent, whether Stealth technology can be achieved at an affordable price.

After these tests are completed, the Department of Defense, Congress, and the American public will have a better idea of who is winning the race between developing Stealth technology and anti-Stealth technology. We then can determine whether we should continue to spend billions of dollars on the outcome.

■ Rep. Andy Ireland (R) of Florida is a member of the House Armed Services Committee.

The myth of the lone gunslinger

In the gulf, the Stealth fighter did not fly solo

Since the gulf war, Air Force officials have been hawking their top gun, the F-117A Stealth fighter, as a lone gunslinger that can do the work of a whole posse of less advanced aircraft. But while the F-117s did a remarkable job in the skies over Baghdad, they were neither as self-sufficient nor as invisible as the Air Force has claimed. "The truth isn't as flashy as the Air Force would have it," says a knowledgeable defense source.

In its campaign to parlay the Stealth's success in the gulf into congressional support for a new generation of stealthy aircraft, notably the B-2 bomber, the Air Force has exaggerated the F-117's accomplishments. A chart provided by the Air Force to Congress indicates that the Stealth fighter received no support from electronic combat planes during the war. The Senate Armed Services Committee drew exactly that conclusion from Air Force testimony and reprinted the chart in a July report on the defense budget, in which it endorsed the Bush administration's request for four B-2s at a cost of \$2.5 billion.

Diversionary tactics. But Air Force officials now concede that some F-117s received support from EF-111 Ravens that jammed and deceived Iraqi air defense radars. Electronic warfare, the sources say, was also used to divert the Iraqis' attention from areas where the Stealth fighters were attacking. Finally, defense sources say, the F-117 was spotted from 100 miles away by Navy E-2C Hawkeye surveillance planes, which use a sophisticated low-frequency radar. The sources say their quarrel is not with the concept of stealth nor with the way the allied coalition fought the air war, only with the Air Force's exaggerated claims for the technology.

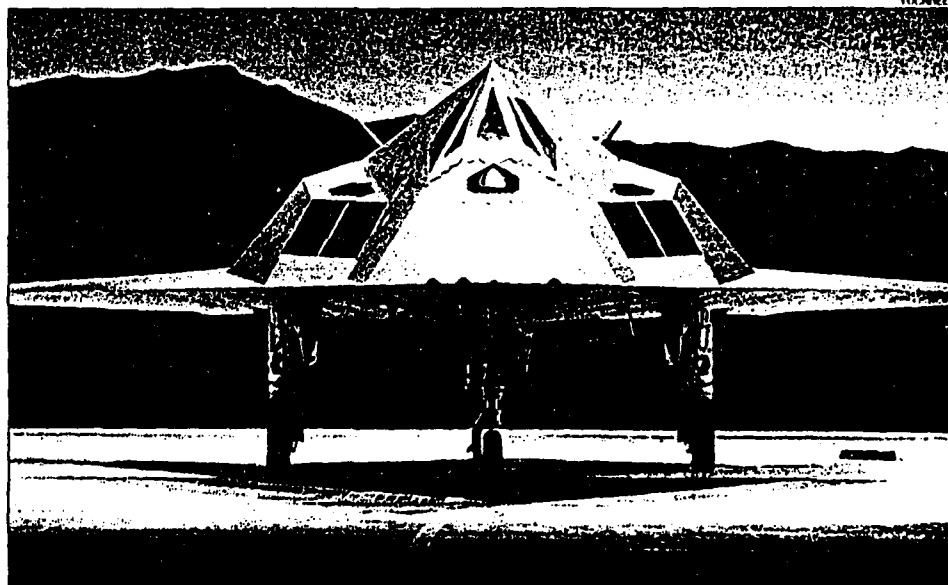
Although they did not always operate alone, as the Air Force had suggested in its congressional presentations, the F-117s did not need the same enormous "support packages" of electronic combat planes, fighters and tankers that

conventional aircraft require. Typically, Air Force F-4G Wild Weasels and EC-130 Compass Call airplanes and Navy EA-6B Prowlers, which deceive or destroy enemy radars, escort nonstealthy bombers to their targets. But such escorts could prove fatal to stealthy aircraft, which rely on surprise. "Escort jamming would act as a beacon and at-

swamped with targets, it has no way to exploit that information," says a former senior Defense Department official.

Air Force officials, however, have been trying to convince Congress that Stealth planes are more economical because they do not need support from radar jammers, tankers or fighters. Air Force Secretary Donald Rice told Congress in February that eight F-117s with precision-guided bombs can do the job of 75 nonstealthy planes. The Air Force claims that two B-2s, which incorporate more advanced stealth technology than do the F-117s, can do the job of 75 aircraft that cost \$6.5 billion. And of the 75 aircraft in the "standard package" described by the Air Force, fewer than half carry bombs.

While Air Force officials now concede that the Stealth fighters received support, they say the F-117s could have



Exaggerated claims. Despite what the Air Force has said, F-117s got help from other planes.

tract attention to the 117s," explains one knowledgeable defense source.

But instead of dispensing with the jammers, air planners in the gulf used electronic warfare planes to distract the Iraqi air defenses. "If you can light up the Baghdad air defense system by flying a jammer through and get them to focus fire in a certain area," says one source, "then the Stealths could go in undetected somewhere else." And while they did not fly with the Stealths, EF-111s operating at a distance from the target areas jammed Iraqi air defense radars where the F-117s were attacking. The F-117s also benefited, as did nonstealthy planes, from allied attacks on the Iraqi air defense network. "Some radars may get glimpses of Stealth aircraft, but if the radar system is already

operated without it. They also say some F-117s flew many missions without help from radar jammers or other aircraft.

But the gulf war demonstrated that stealth is even more powerful when it is supported by other assets. That means that while the stealthy planes can operate with less support than other aircraft, buying expensive Stealth aircraft does not mean doing without all the unglaorous electronic combat planes. "If the premium is on saving lives," says one informed source, "it would be crazy not to use tactics to ensure the survivability of these aircraft and their pilots." And as the gulf war demonstrated, military commanders will use every tool at their disposal.

By BRUCE B. AUSTER